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SUBJECT: BENEFICIAL USE-PROTECTIVE WATER QUALITY LIMITS FOR COMPONENTS OF PETROLEUM-BASED FUELS

In an earlier memorandum, I summarized available water quality limits for petroleum fuel mixtures, constituents and additives. Several of the relevant limits have changed and additional limits have been proposed. The discussion below presents the information contained in my earlier memorandum, along with updated and pending numerical limits in the attached tables.

Discussion:

A significant amount of our work involves the assessment and mitigation of petroleum-based fuel spills into soil and water. Various water quality criteria have been cited by staff in determining whether beneficial uses have been impaired or threatened by such spills. In an effort to achieve uniformity in the use of numerical water quality limits for this purpose and to bring to your attention the wide range of available and relevant criteria, I offer the list on the following pages. These limits are intended to be used to interpret applicable Basin Plan water quality objectives for the protection of existing or potential sources of drinking water. Sources of drinking water are surface and ground waters which have the beneficial use of municipal and domestic supply (MUN), as designated in the applicable *Water Quality Control Plan* (Basin Plan) or the State Water Board "Sources of Drinking Water" Policy, Resolution No. 88-63. Water quality objectives applicable to MUN waters include *Chemical Constituents* (which requires compliance with California drinking water MCLs and generally prohibits adverse effects on beneficial uses), *Toxicity* (which prohibits toxic chemicals in toxic amounts) and *Tastes and Odors* (which prohibits adverse tastes and odors nuisance conditions). Additional objectives and numerical limits may apply to petroleum fuels in surface waters in addition to those contained in this memorandum.

The Basin Plan requires consideration of numerical water quality limits to implement each of these objectives. In most cases, the most stringent of the listed limits for each chemical would implement all three objectives. A discussion of the use of numerical limits to implement narrative water quality objectives is contained in the staff report *A Compilation of Water Quality Goals*, August 2000 edition.

Certain of the recommended limits are lower than applicable analytical detection limits in water. In these cases, the confirmed detection of any amount of these constituents in water indicates that beneficial uses have been impaired.

In addition, an assessment of existing and potential water quality impacts must take into account State Water Board Resolution Nos. 68-16, *Statement of Policy With Respect to Maintaining High Quality of Waters in California*, and 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*. Conformance with these policies in the Central Valley Region is described in the Implementation Chapter of the Basin Plans under the headings, *Antidegradation Implementation Policy*, *Policy for Application of Water Quality Objectives*, and *Policy for Investigation and Cleanup of Contaminated Sites*. Requiring cleanup to technologically and economically achievable levels which are lower than beneficial use-protective limits, would be consistent with these policies for water quality control.

Attachment

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

Constituent	Water Quality Objective (a)	Numerical Limit Interpreting Water Quality Objective		
		Source	Limit	Units
Aromatic Hydrocarbons:				
Benzene	Chemical Constituents	California Primary MCL (b)	1.0	ug/L
	Toxicity	California Public Health Goal (OEHHA)	0.15	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	170	ug/L
n-Butylbenzene	Chemical Constituents			
	Toxicity	California Drinking Water Action Level (DHS)	70	ug/L
	Tastes and Odors			
Ethylbenzene	Chemical Constituents	California Primary MCL (b)	700	ug/L
	Chemical Constituents	Proposed California Primary MCL (d)	300	ug/L
	Toxicity	California Public Health Goal (OEHHA)	300	ug/L
	Tastes and Odors	Federal Register, Vol. 54, No. 97, pp. 22138,22139	29	ug/L
Isopropyl benzene	Chemical Constituents			
	Toxicity	USEPA IRIS Reference Dose (i)	700	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	0.8	ug/L
Toluene	Chemical Constituents	California Primary MCL (b)	150	ug/L
	Toxicity	California Public Health Goal (OEHHA)	150	ug/L
	Tastes and Odors	Federal Register, Vol. 54, No. 97, pp. 22138,22139	42	ug/L
1,2,4-Trimethylbenzene	Chemical Constituents			
	Toxicity	California Public Health Goal (OEHHA)	330	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983 (g)	15	ug/L
1,3,5-Trimethylbenzene	Chemical Constituents			
	Toxicity	California Public Health Goal (OEHHA)	330	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	15	ug/L
Xylenes (sum of isomers)	Chemical Constituents	California Primary MCL (b)	1750	ug/L
	Toxicity	California Public Health Goal (OEHHA)	1800	ug/L
	Tastes and Odors	Federal Register, Vol. 54, No. 97, pp. 22138,22139	17	ug/L
Aliphatic Hydrocarbons:				
n-Hexane	Chemical Constituents			
	Toxicity	USEPA Health Advisory (e)	400	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	6.4	ug/L
Hydrocarbon Mixtures:				
Diesel or Kerosene	Chemical Constituents			
	Toxicity	USEPA Superfund Provisional Reference Dose (i)	56-140	ug/L
	Tastes and Odors	Taste & odor threshold from USEPA Health Advisory	100	ug/L
Gasoline	Chemical Constituents			
	Toxicity	USEPA Superfund Provisional Cancer Slope Factor (c)	21	ug/L
	Tastes and Odors	McKee & Wolf, *Water Quality Criteria* , SWRCB, p. 230	5	ug/L
Additives:				
Lead	Chemical Constituents	California Primary MCL (b)	15	ug/L
	Toxicity (h)	California Public Health Goal (OEHHA)	2	ug/L
	Tastes and Odors			
Ethylene dibromide (EDB)	Chemical Constituents	California Primary MCL (b)	0.05	ug/L
	Toxicity	Cal/EPA Cancer Potency (c)	0.0097	ug/L
	Tastes and Odors			
Ethylene dichloride	Chemical Constituents	California Primary MCL (b)	0.5	ug/L
(1,2-Dichloroethane)	Toxicity	California Public Health Goal (OEHHA)	0.4	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	7000	ug/L
Methyl t-butyl ether (MtBE)	Chemical Constituents	California Primary MCL (b)	13	ug/L
	Chemical Constituents	California Secondary MCL (f)	5	ug/L
	Toxicity	California Public Health Goal (OEHHA)	13	ug/L
	Tastes and Odors	California Secondary MCL	5	ug/L
Di-isoproply ether (DIPE)	Chemical Constituents			
	Toxicity			
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	0.8	ug/L
t-Butyl alcohol (TBA)	Chemical Constituents			
	Toxicity	California Drinking Water Action Level (DHS)	12	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	290,000	ug/L
Ethanol	Chemical Constituents			
	Toxicity			
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	760,000	ug/L
Methanol	Chemical Constituents			
	Toxicity	USEPA IRIS Reference Dose (i)	3500	ug/L
	Tastes and Odors	Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	740,000	ug/L

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

Constituent	Water Quality Objective (a)	Numerical Limit Interpreting Water Quality Objective		
		Source	Limit	Units
Polynuclear Aromatic Hydrocarbons (PAHs or PHAs):				
Carcinogenic PAHs -- sum as benzo(a)pyrene equivalents (j)	Chemical Constituents Toxicity Tastes and Odors	Cal/EPA Cancer Potency (c)	0.0029	ug/L
Acenaphthene	Chemical Constituents Toxicity Tastes and Odors	 USEPA IRIS Reference Dose (i) USEPA National Ambient Water Quality Criteria	 420 20	 ug/L ug/L
Anthracene	Chemical Constituents Toxicity Tastes and Odors	USEPA IRIS Reference Dose (i)	2100	ug/L
Benz(a)anthracene	Chemical Constituents Toxicity Tastes and Odors	Proposed USEPA Primary MCL (d) see "Carcinogenic PAHs" above	0.1	ug/L
Benzo(a)pyrene	Chemical Constituents Toxicity Tastes and Odors	California Primary MCL (b) see "Carcinogenic PAHs" above	0.2	ug/L
Dibenz(a,h)anthracene	Chemical Constituents Toxicity Tastes and Odors	Cal/EPA Cancer Potency (c)	0.0085	ug/L
7,12-Dimethylbenz(a) anthracene	Chemical Constituents Toxicity Tastes and Odors	Cal/EPA Cancer Potency (c)	0.00014	ug/L
Fluoranthene	Chemical Constituents Toxicity Tastes and Odors	USEPA IRIS Reference Dose (i)	280	ug/L
Fluorene	Chemical Constituents Toxicity Tastes and Odors	USEPA IRIS Reference Dose (i)	280	ug/L
Naphthalene	Chemical Constituents Toxicity Tastes and Odors	 USEPA IRIS Reference Dose (i) Amoore and Hautala, *J. Applied Tox.* , Vol.3, No.6, 1983	 14 21	 ug/L ug/L
Pyrene	Chemical Constituents Toxicity Tastes and Odors	USEPA IRIS Reference Dose (i)	210	ug/L

Notes:

(a) Water Quality Objectives for groundwater from the *Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin* , Fourth Edition (1998):

Chemical Constituents

Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.

At a minimum, ground waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain lead in excess of 0.015 mg/l. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs.

Toxicity

Ground waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s). This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

Tastes and Odors

Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

(b) Primary MCLs are human health based, but also may reflect other factors relating to technologic and economic feasibility of attainment and monitoring in a water distribution system and at the tap. These factors may not be relevant for the water resource.

(c) 1-in-a-million cancer risk estimate derived from published oral cancer slope factor by assuming 2 liters/day water consumption and 70 kg body weight.

(d) If adopted as proposed, this limit would become the numerical limit used to interpret this objective.

Water Quality Numerical Limits for Petroleum Fuel Mixtures, Constituents and Additives

Notes (continued):

(e) Health advisory = 4000 ug/L for 10 day exposure or less. No lifetime exposure advisory has been developed. However, lifetime health advisories are normally at least ten-fold lower than 10-day advisories. Therefore, a level of 400 ug/L would be a reasonable estimate of a lifetime protective level.

(f) Secondary MCLs are human welfare based, but also may reflect other factors relating to technologic and economic feasibility of attainment and monitoring in a water distribution system and at the tap. These factors may not be relevant for the water resource.

(g) Value listed is for 1,3,5-trimethylbenzene. Taste and odor treshold should be similar for 1,2,4-trimethylbenzene.

(h) Liability under Proposition 65 may also exist for responsible parties where levels in water exceed 0.25 ug/L.

(i) Listed value assumes 2 liters/day water consumption, 70 kg body weight, and 20% relative source contribution from drinking water.

(j) Concentrations of individual PAHs are adjusted by dividing the concentrations by the potency equivalency factors (PEFs) in the table on the following page. The limit applies to the sum of these adjusted concentrations.

Office of Environmental Health Hazard Assessment (OEHHA)
Weighting Scheme for Polyaromatic Hydrocarbons (PAH's)

PAH or derivative	CAS number	Suggested PEF
benzo[a]pyrene	50-32-8	1.0 (index compound)
benz[a]anthracene	56-55-3	0.1
benzo[b]fluoranthene	205-99-2	0.1
benzo[j]fluoranthene	205-82-3	0.1
benzo[k]fluoranthene	207-08-9	0.1
dibenz[a,j]acridine	224-42-0	0.1
dibenz[a,h]acridine	226-36-8	0.1
7H-dibenzo[c,g]carbazole	194-59-2	1.0
dibenzo[a,e]pyrene	192-65-4	1.0
dibenzo[a,h]pyrene	189-64-0	10
dibenzo[a,i]pyrene	189-55-9	10
dibenzo[a,l]pyrene	191-30-0	10
indeno[l ,2,3-c,d]pyrene	193-39-5	0.1
5-methylchrysene	3697-24-3	1.0
l-nitropyrene	5522-43-0	0.1
4-nitropyrene	57835-92-4	0.1
1,6-dinitropyrene	42397-64-8	10
1,8-dinitropyrene	42397-65-9	1.0
6-nitrocrysene	7496-02-8	10
2-nitrofluorene	607-57-8	0.01
chrysene	218-01-9	0.01

This weighting scheme for PAH's was developed by the Air Toxicology and Epidemiology Section (ATES) of the Office of Environmental Health Hazard Assessment (OEHHA) in the document entitled Health Effects of Benzo[a]pyrene. The nitro PAHs are those listed as IARC class 2B. Although chrysene is an IARC class 3 carcinogen, USEPA classifies it as B2. The justification for each PEF is detailed in Appendix A of the document entitled the Health Effects of Benzo[a]pyrene.

These PEF's may be used for both inhalation and oral exposure pathways, although data used for their development was prioritized so inhalation exposure was given higher priority than other routes of exposure. When a specific potency value is developed for a chemical it should be used in place of the PEF.

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